Natural Gas Compressor Stations
Greenhouse Gas PSD Applicability Example
Sample Calculation Problems

Example 3. Hypothetical Natural Gas Compressor Station Scenario

Proposed Project: A new natural gas compressor station is proposed to help transport the field gas to the natural gas transmission system. For this hypothetical example, the facility emitting units consists of twenty five (25) 800 brake horsepower (bhp) compressor engines and three (3) reboilers/dehydrators.

(Note: Other emitting units can exist at a natural gas compressor station but only these two emitting units are included for example purposes only.)

Given:

The proposed facility consists of the following emitting units:

1. Twenty five (25) 800 brake horsepower (bhp) compressor engines
2. Three (3) reboilers/dehydrators

Other miscellaneous assumptions/information:

1. Compressor Engine Fuel Consumption = 8500 Btu/bhp-hr @ Maximum Design Capacity
2. Reboiler Fuel Consumption = 256 MBtu/hr @ Maximum Design Capacity
3. Natural Gas Heat Value = 1020 Btu/scf

Example emission factors for criteria pollutants and greenhouse gases (GHG) associated with the compressor engines and reboilers are provided in the tables below.

Table 1. Compressor Engine Emission Factors

Pollutant	Emission Factors	Units
Particulate Matter (PM_{10})	10	lb/MMscf
Sulfur Dioxide (SO_2)	0.002	g/bhp-hr
Nitrogen Dioxide (NO_x)	15	g/bhp-hr
Volatile Organic Compounds (VOC)	0.2	g/bhp-hr
Carbon Monoxide (CO)	1.4	g/bhp-hr
Carbon Dioxide (CO_2)	116.87	lb/MMscf
Methane (CH_4)	0.011014	lb/MMscf
Nitrous Oxide (N_2O)	0.000022	lb/MMscf

Table 2. Reboiler Emission Factors

Pollutant	Emission Factors	Units
PM_{10}	5	lb/MMscf
SO_2	0.6	lb/MMscf
NO_x	100	lb/MMscf
VOC	8	lb/MMscf
CO	20	lb/MMscf
CO_2	116.87	lb/MMscf
CH_4	0.011014	lb/MMscf
N_2O	0.000022	lb/MMscf

Problem Solving:

Problem #1. What are the potential emissions associated with the compressor engines and reboiler units?

Example Calculations:

Potential VOC emissions from the compressor engines.

VOC Emissions (Tons/yr) = (0.2 g/bhp-hr) * (800 bhp) * (1lb/454g) * (1 ton/2000 lb) * (8760 hr/yr) = 1.54 tons/yr * 25 engines = 38.5 tons/yr

Potential VOC emissions from the reboilers.

VOC Emissions (Tons/yr) = (8 lb/MMscf) * (1MMscf/1,000,000scf) * (256 MBtu/hr) * (1000 btu/MBtu) * (1scf/1020 Btu) * 1 ton/2000 lb * 8760 hrs/yr = 0.01 tons/yr * 3 reboilers = 0.03 tons/yr

Please calculate the potential NO_x emission for the twenty five (25) compressor engines in tons/yr using the information provided above.

Please calculate the potential NO_x emission for the three (3) reboilers in tons/yr using the information provided above.

Table 3. Calculated Potential Emissions for the Compressor Engines and Reboilers

Potential Emissions in Tons/yr

	PM_{10}	**SO_2**	**NO_x**	**VOC**	**CO**	**CO_2**	**CH_4**	**N_2O**
Compressor Engines (25)	6.5	0.5	2,892	38	225	87,000	8.2	0.02
Reboilers (3)	0.03	0.00	0.33	0.03	0.06	393	0.037	0.00007
Total =	**6.5**	**0.5**	**2,892**	**38**	**225**	**87,393**	**8.2**	**0.02**

Problem #2. In terms of mass, what are the total emissions from GHGs?

Total Emissions of GHGs in tons/yr = CO_2 + CH_4 + N_2O (Refer to Table 3.)

87,393 tons/yr + 8.2 tons/yr + 0.02 tons/yr = _____ tons/yr

Problem #3. What are the total emissions of CO_2 equivalent (CO_2e)?

Step 1. In order to determine CO_2e, Refer to Table A-1 of CFR Title 40, Part 98, Subpart A, for the Global Warming Potentials (GWP).

Step 2. Indentify the GHG pollutants (e.g., CO_2, CH_4, and N_2O) and their Global Warming Potentials (GWPs) as shown below.

Pollutant	Global Warming Potential (GWP)
CO_2	1
CH_4	21
N_2O	310

Step 3. Calculate CO_2e using the following equation:

CO_2e (tons/yr) = ∑(Mass Emission Rate (tons/yr) * GWP)

CO_2e (tons/yr) = (87,393 tons/yr*1)+(8.2 tons/yr*21)+(0.02 tons/yr*310)=_____ tons/yr

CO_2e (tons/yr) = 87,571 tons/yr

Summary GHG and CO_2e Emissions:

GHGs (Mass)	CO_2e
87,393 tons/yr	87,571 tons/yr

PSD Applicability Summary Analysis:

Question #1: Does this permit action result in an increase of any criteria pollutant above PSD threshold levels?

Question #2: Does this permit action have GHG emissions above the PSD threshold on a mass basis?

Question #3: Does this permit action have CO_2e emissions above the PSD threshold?

While a PSD review would be required for NO_x, the answer to Questions #2 and #3 must both be "Yes" for GHGs to undergo a PSD review. Because the answer to Questions #2 and #3 was yes, a PSD review would be required for GHGs in this hypothetical scenario.

Title V Applicability Analysis/Overview:

Question #1: Are the potential emissions of any criteria pollutant greater than 100 tons per year?

Question #2: Are the potential emissions of GHGs greater than 100 tons per year?

Question #3: Are the potential emissions as CO_2e greater than 100,000 tons per year?

If the answer to Questions #1, #2, and #3 is "Yes", a Title V permit action to address GHGs are described in the following scenarios.

- A department decision occurring before January 2, 2011, would not require GHGs to be addressed in the Title V permit.
- A department decision occurring after January 2, 2011, must address GHGs in the Title V permit.
- A department decision occurring after July 1, 2011, must address GHGs in the Title V permit.

If the answer to Questions #2 and #3 is "Yes", a Title V permit action to address GHGs are shown as follows:

- A department decision occurring before January 2, 2011, would not require GHGs to be addressed in the Title V permit.
- A department decision occurring after January 2, 2011, would not require GHGs to be addressed in the Title V permit.
- A department decision occurring after July 1, 2011, would require GHGs to be addressed in the Title V permit.